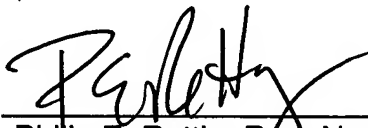


**REMARKS**

Claims 1-15 are now pending in the application. The purpose of this Preliminary Amendment is to place the English translation of the application in a more traditional U.S. format, to amend the claims, and to add new claims. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

Dated: May 12, 2005

By:   
Philip E. Rettig, Reg. No. 34,000  
Jason A. Heist, Reg. No. 51,797

HARNESS, DICKEY & PIERCE, P.L.C.  
P.O. Box 828  
Bloomfield Hills, Michigan 48303  
(248) 641-1600

PER/JAH

(12) INTERNATIONAL APPLICATION PUBLISHED IN ACCORDANCE WITH THE INTERNATIONAL PATENT COOPERATION TREATY (PCT)

(19) World Organization for Intellectual Property [Logo:] [Bar code]  
International Office  
OMPI (10) Internat. Publication No.:  
(43) Internat. Publication Date: WO 03/081080 A1  
October 2, 2003 (10.02.2003) PCT

(51) Internat. Patent Classif.<sup>7</sup>: F16F 13/26 (72) Inventor: and  
(21) Internat. File No.: PCT/EP03/03124 (75) Inventor/Applicant (for US only):  
(22) Internat. Filing Date: March 26, 2003 (03.26.2003) FREUDENBERG, Tillmann; Ortstrasse 19,  
[DE/DE]; Zur Waldwiese 5, 69517 64658 Fürth/Steinbach (DE), MOOG, Erhard  
(25) Filing Language: German Gornheimtal (DE)  
(26) Publication Language: German (81) Designated States (national): AE, AG, AL, AM, AT,  
(30) Priority Data: 102 13 996.2 March 27 2002 (03.27.2002) DE AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CN, CO, CR,  
CU, CZ, DK, DM, DZ, EE, GD, GE, GH, GM, HR,  
(71) Applicant: (for all designated states except the US): CARL FREUDENBERG KG [DE/DE]; HÜHNERWEG 2-4, 69469 Weinheim (DE) HU, ID, IL, IN, IS, KE, KG, KP, KR, KZ, LC, LK, LR,  
MG, MK, MN, MW, MX, MZ, NO, NZ, PL, RO, RU,  
LS, LT, LV, MA, MD, SD, SG, SK, SL, TJ, TM, TT,  
TZ, UA, UG, US, UZ, VN, YU, ZA, ZW  
Declaration according to Rule 4.17: (84) Designated States (regional): ARIPO pat. (GH, GM,  
- Inventor declaration (Rule 4.17, item iv) KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW  
- for US only Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU  
Published: TJ, TM), European pat. (AT, BE, BG, CH, CY, CZ,  
- with Search Report DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU,  
- before expiration of deadline for claim amendments; MC, NL, PT, RO, SE, SI, SK, TR), AOP patent (BF,  
- publication will be repeated if changes occur. BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR,  
NE, SN, TD, TG).

For an explanation of the two-letter code and of the other abbreviations, the reader is referred to the explanations ("Guidance Notes on Codes and Abbreviations" appearing at the beginning of every issue of the PCT Gazette).

(54) Title: SWITCHABLE ASSEMBLY BEARING WITH HYDRAULIC DAMPING

(57) Abstract: The invention relates to a switchable assembly bearing (1) with hydraulic damping, especially for supporting drive and/or gearbox assemblies in motor vehicles. Said bearing comprises at least one working chamber (10) and one compensation chamber (20) which are separated by a dividing wall (50), but are hydraulically interconnected by means of a damping channel (60), in addition to at least one other damping channel (70) which can be closed

[Continued on next page]

by means of the sealed arrangement of a shut-off body (90) which can be displaced along a displacement path. According to the invention, the other damping channel is formed and arranged in relation to the axis of symmetry of the bearing in such a way that the forces acting on the shut-off body by means of the hydraulic fluid counterbalance each other. As a result, virtually no forces act on the shut-off body which can be moved back and forth between a closing position and an opening position by means of only few displacement forces, the actuating mechanism for the shut-off body being significantly simplified and also enabling a significantly simpler and more compact construction of the assembly.

Applicant: Carl Freudenberg KG, 69469 Weinheim

## Switchable Assembly Bearing with Hydraulic Damping

### Description

#### Cross-Reference to Related Applications

This application is a National Stage of International Application No. PCT/ / filed . This application claims the benefit of [INSERT FOREIGN APPLICATION COUNTRY AND SERIAL NO.], filed [INSERT FILING DATE OF FOREIGN APPLICATION]. The disclosure(s) of the above application(s) is (are) incorporated herein by reference.

#### Technical Field of the Invention

The invention relates to a switchable assembly bearing with hydraulic damping, particularly for supporting drive assemblies and/or gearbox assemblies in motor vehicles. The said bearing comprises at least one working chamber and one compensation chamber that are separated from one another by a dividing wall. The working chamber and compensation chamber, but are interconnected hydraulically by means of a damping channel, and at least one additional damping channel that can be closed by means of a shut-off body displaceable along a displacement path. The, said shut-off body is being capable of providing a sealing in cooperation with an associated seat.

#### Description of the Prior Art

An assembly bearing ~~of the said kind~~ is known from, for example, DE 198 61 063 C2. The known assembly bearing has a working space and a compensation space with a dividing wall disposed between them. Moreover, between the working space and the compensation space the known assembly bearing comprises a damping channel for damping low-frequency, high-amplitude vibrations, ~~and for~~ isolating high-frequency, low-amplitude vibrations there is provided a membrane disposed in a recess and capable of moving back and forth in the direction of the vibrations introduced. In addition, the known assembly bearing is provided centrally within the dividing wall with an aperture that can be closed in a sealing manner by means of a shut-off body that is displaceable within

the bearing and cooperates with an associated seat in the dividing wall.

In an axial direction, the dividing wall consists of two parts and forms a membrane cage. The above-said membrane is being disposed within the membrane cage. ~~The above-said~~ membrane is made of an elastomeric material, is circular in shape and has a central recess corresponding to the aperture.

#### ~~CONFIRMATION COPY~~

For quenching of ~~the~~ vibrations caused during the idling of an attached internal combustion engine, the sealing body is removed from the aperture by downward axial displacement so that the liquid column can move within the aperture out of phase relative to the vibrations caused by the idling. This produces a quenching effect.

During the operation of the internal combustion engine above the idling rotational speed, the aperture is closed by the sealing body, and under these operating conditions the bearing of the invention functions as do the generally known hydraulically damping bearings, in which, to isolate high-frequency, low-amplitude engine-induced vibrations, the membrane is disposed within the dividing wall so that it can move back and forth. For the damping of low-frequency, high-amplitude, roadway-induced vibrations, the damping liquid contained within the damping channel vibrates back and forth in an out-of-phase manner.

A drawback of the known assembly bearing, however, is that the central aperture strongly reduces the surface area available for the membrane. This has a deleterious effect on the damping of low-amplitude, high-frequency acoustic vibrations. Moreover, in the central aperture the sealing body must be able to resist or move against the ~~possibly~~ increased pressure in the working space, which requires higher displacement forces. Other drawbacks are the complicated design of the known assembly bearing and the large dimensions thereof.

#### SummaryRepresentation of the Invention

An~~The~~ object of the present invention is to further develop an assembly bearing ~~of the known-kind~~ in a manner such that it will be of simpler design and require a smaller mounting space and, in addition, reduced displacement forces for idling. ~~This objective is reached with an assembly bearing having all the characteristics indicated in Claim 1. Advantageous embodiments of the invention are described in the subclaims.~~

The present invention makes use in simple manner of the symmetry of an assembly

bearing relative to its long axis. According to the invention, ~~in a switchable assembly bearing with hydraulic damping, particularly for the support of drive assemblies and/or gearbox assemblies in motor vehicles, is provided that comprising~~ at least one working chamber and one compensation chamber that are separated by a dividing wall. The working chamber and compensation chamber are ~~but are~~ hydraulically interconnected through a damping channel, and at least one additional damping channel that can be closed by a shut-off body displaceable along a displacement path and cooperating with an associated seat. The additional damping channel is configured and disposed relative to the symmetry axis of the bearing so that the forces acting on the shut-off body through the hydraulic liquid counterbalance each other. This has the advantage that substantially lower displacement forces are needed to displace the shut-off body and, as a result, the assembly bearing can be of small and compact design.

In an advantageous embodiment of the invention, the damping channel is formed in a simple manner as an annular slot that extending radially around the aperture between the working chamber and the compensation chamber, with a passage opening disposed radially relative to the symmetry axis toward a corresponding annular slot-like connecting chamber that leading to the compensation chamber. In this embodiment, the shut-off body is formed by a sealing ring displaceable back and forth along a displacement path that extending vertical to the flow-through direction, namely parallel to the bearing axis, between an opening position and a closing position. With such a ~~the described~~ technical arrangement, by making use of the symmetry of the assembly bearing, it is possible to achieve ~~in a particularly simple manner~~ virtual compensation of the forces acting on the shut-off body. ~~As a rule,~~ such forces are a result of a pressure build-up in the working chamber. These forces act generally on the sealing ring in the direction vertical to the displacement path and counterbalance each other. On the side of the compensation chamber, a pressure build-up that could produce troublesome forces is largely prevented by the connection with the compensation chamber which at the bottom is limited by air bellows capable of absorbing volume without generating pressure.

In addition to the fact that the damping channel is designed as an annular slot and the shut-off body as a sealing ring, ~~in principle~~ it is also possible ~~conceivable~~ to make use of several passage openings disposed diametrically opposite each other and whose shut-off bodies are operationally connected with each other. In such an arrangement, too, by making use of the symmetry, nearly complete force compensation can be achieved. ~~This, however, involves a considerable technical effort.~~

In a particularly preferred embodiment of the invention, the chamber providing the connection to the compensation chamber is attached to the additional damping channel in a radially outward direction. This has the advantage that the entire inner surface of the

dividing wall is available for the placement of the membrane.

Because, as a result of extensive force compensation, only slight displacement forces are needed, magnetic forces can be used to actuate the shut-off body or the sealing ring. To this end, the shut-off body or the sealing ring— are advantageously provided with a permanently magnetic material, and a device is provided for generating the appropriate switching magnetic fields.

The device for generating magnetic fields is preferably an electromagnet.

When the additional damping channel is in the form of an annular slot and the shut-off body in the form of a sealing ring, the electromagnet is advantageously ~~also~~, at least in segments, in the form of a ring corresponding to the sealing ring.

In an especially simple space-saving design, the electromagnet is disposed in a chamber adjacent to the chamber connecting with the compensation space containing the shut-off body.

In another particularly preferred embodiment of the invention, the shut-off body or the sealing ring consists of a magnetic elastomer. The density of elastomers is preferably usually in the range of the density of the damping liquid so that as a result of this measure the displacement forces for the shut-off body are further reduced.

The required mounting space is further minimized when the damping channel is at least partly disposed in the dividing wall between the working chamber and the compensation chamber.

In particular, the additional damping channel is sized so that it is suitable for decoupling and quenching low-frequency, high-amplitude vibrations of an idling drive assembly.

If, besides the first and the additional damping channel, the switchable assembly bearing of the invention is provided with yet another known decoupling device for quenching and damping high-frequency, low-amplitude acoustic vibrations, the switchable assembly bearing of the invention combines in itself all advantages of an idling switchable bearing in itself known, but in contrast to the known versions is characterized by a simple design, compact construction and low energy requirements.

Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the

invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

### **Brief Description of the Drawings**

In the following, the invention will be explained in greater detail by reference to the drawings in which:

Figures 1a and 1b—show a schematic representation of a longitudinal section of a ————  
———preferred embodiment of a switchable assembly bearing in the ———  
———closed position (a) and with the additional damping channel open ———  
———(b).

### **Detailed Description of the Preferred Embodiments**

The following description of the preferred embodiment(s) is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

Figures 1a and 1b show a hydraulically damped assembly bearing 1—of the invention provided with a working chamber 10 and a compensation chamber 20—and which are filled with a common hydraulic fluid. Working chamber 10 is limited by a wall 3 having a truncated conical shape and made of an elastic material, known as the bearing spring. Compensation chamber 20 is limited at the bottom by a cup-shaped wall 4, also made of an elastic material, for example by an air bellows capable of absorbing volume without creating pressure. On the side of the engine, a peripheral wall 3 receives a bearing plate 3.1. The said plate is being provided with a protruding screw bolt 3.2 for fastening to the engine. Between working chamber 10 and compensation chamber 20 is located a dividing wall 50 in which is disposed a membrane cage 52 for receiving a membrane 54. In the dividing wall 50 is also disposed a damping channel 60 which hydraulically interconnects the two liquid-filled chambers 10 and 20. The lower limiting wall 4 of compensation chamber 20 is surrounded by a housing 4.1 on which there is provided a vertically protruding screw bolt 4.2 for fastening assembly bearing 1 on the side of the vehicle body.

According to the invention, an additional damping channel 70 for quenching the idling-induced vibrations is disposed in dividing wall 50. It can be seen in the sectional representation of the present embodiment—of the invention—that the additional damping channel 70 makes an approximately 90° bend from the vertical to the horizontal direction and ends in connecting chamber 80 which provides the connection with compensation



chamber 20. This means that in the embodiment shown, the additional damping channel 70 and the connecting chamber 80 constitute an annular slot in the form of a peripherally extending aperture. In connecting chamber 80 is located as shut-off body a sealing ring 90 made of an elastomeric magnetic material. In connecting chamber 80, a sealing ring 90 is movable back and forth in the axial direction between an open position and a closed position between two studs 81, 82 that acting as stops.

It can be seen from Figures 1a and 1b that the displacement path of sealing ring 90 extends vertically in the direction of the mouth -of additional damping channel 70. It is made certain in this manner that sealing ring 90, even if subjected to a pressure stress, can continue to move through additional channel 70 virtually without force application, because the forces acting on the sealing ring from the side of the working chamber counterbalance each other. On the side of the compensation chamber, the build-up of a pressure gradient that could lead to troublesome forces is prevented by an air bellows 4 that is capable of absorbing volume without creating pressure. To actuate sealing ring 90 there is provided an electromagnet 100 which in correspondence with sealing ring 90 also extends peripherally and which is disposed on a chamber 85 that is directly adjacent to connecting chamber 80. In the closed position shown in Figure 1, sealing ring 90 rests on the lower stud 82 and with its internal radial surface seals the additional damping channel 70 in liquid-tight manner.

The polarity reversal of the electromagnet puts sealing ring 90 into the open position represented in Figure 1b. TheSaid ring 90 touches upper stud 81 thus freeing the passage opening of the additional damping channel 70 toward connecting chamber 80.

Because of its permanent magnetic properties, sealing ring 90 can be kept in the position shown without the need for a current.

The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.

## CLAIMS

What is claimed is:

\_\_\_\_\_1. Switchable assembly bearing (1) with hydraulic damping, particularly for supporting drive assemblies and/or gearbox assemblies in motor vehicles, comprising at least one working chamber (10) and one compensation chamber (20) that are separated from one another by a dividing wall (50), but are hydraulically interconnected through a damping channel (60), and at least one additional damping channel (70) that can be closed by means of a shut-off body displaceable along a displacement path, said shut-off body being capable of providing sealing by contact with an associated seat, characterized in that the additional damping channel is configured and disposed relative to the symmetry axis of the bearing so that the forces acting on the shut-off body through the hydraulic liquid counterbalance each other.

\_\_\_\_\_2. Switchable assembly bearing (1) according to Claim 1, characterized in that the damping channel (70) forms an aperture between the working chamber (10) and the compensation chamber (20) in the form of a radially surrounding annular slot with a passage opening disposed radially relative to the symmetry axis and directed toward compensation chamber (20), and that the shut-off body (90) is formed by a sealing ring disposed at this passage opening and displaceable along a displacement path that extends vertical to the passage opening between an open position and a closed position.

\_\_\_\_\_3. Switchable assembly bearing (1) according to Claim 2, characterized in that the passage opening points radially outward.

\_\_\_\_\_4. Switchable assembly bearing (1) according to one of Claims 1 to 3, characterized in that the shut-off body or sealing ring (90) comprises a permanently magnetic material and that there is provided a device for actuating the shut-off body or sealing ring (90) by magnetic forces.

\_\_\_\_\_5. Switchable assembly bearing (1) according to Claim 4, characterized in that the device for actuating the shut-off body or sealing ring (90) is an electromagnet (100).

\_\_\_\_\_6. Switchable assembly bearing (1) according to Claim 5, characterized in that in correspondence to the sealing ring (90) at least segments of the electromagnet (100) are also ring-shaped.

\_\_\_\_\_7. Switchable assembly bearing (1) according to Claim 5 or 6, characterized in

that the electromagnet (100) is disposed in a chamber (85) adjacent to the connecting chamber (80) containing the shut-off body (90) and which provides a connection with the compensation chamber (20).

\_\_\_\_8. Switchable assembly bearing (1) according to one of Claims 4 to 7, characterized in that the shut-off body or sealing ring (90) is made of a magnetic elastomer.

\_\_\_\_9. Switchable assembly bearing (1) according to one of Claims 1 to 8, characterized in that the additional damping channel (70) is disposed at least in part within the dividing wall (50), between the working chamber (10) and the compensation chamber (20).

\_\_\_\_10. Switchable assembly bearing (1) according to one of Claims 1 to 9, characterized in that the additional damping channel (70) for decoupling and quenching low-frequency, high-amplitude vibrations is designed for an idling drive assembly.

\_\_\_\_11. Switchable assembly bearing (1) according to one of Claims 1 to 10, characterized in that there is provided a decoupling device (54) for quenching and damping high-frequency, low-amplitude acoustic vibrations.

### Abstract of the Disclosure

The invention relates to a switchable assembly bearing that comprises at least one working chamber and one compensation chamber which are separated by a dividing wall. The working chamber and compensation chamber are hydraulically interconnected by means of a damping channel, in addition to at least one other damping channel which can be closed by means of the sealed arrangement of a shut-off body which can be displaced along a displacement path. The other damping channel is formed and arranged in relation to the axis of symmetry of the bearing in such a way that the forces acting on the shut-off body by means of the hydraulic fluid counterbalance each other.